Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/NZ05/000059

International filing date: 29 March 2005 (29.03.2005)

Document type: Certified copy of priority document

Document details: Country/Office: NZ
Number: NZ532002
Filing date: 29 March 2004 (29.03.2004)

Date of receipt at the International Bureau: 19 April 2005 (19.04.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

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This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 29 March 2004 with an application for Letters Patent number 532002 made by Rodney Warwick Sharp.

Dated 11 April 2005.

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Patents Form No. 4
Appln Fee: $50.00
Our Ref: 12T2720NZ

PATENTS ACT 1953

PROVISIONAL SPECIFICATION

Title ***Improvements in and Relating to Wood Hogging Apparatus***

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do hereby declare this invention to be described in the following statement:

IMPROVEMENTS IN AND RELATING TO WOOD HOGGING APPARATUS

FIELD OF INVENTION

The present invention is directed towards hogging apparatus. This is typically apparatus for reducing the size of waste wood and timber material for use as a combustible fuel source.

BACKGROUND DESCRIPTION

The present invention is directed to apparatus for reducing or comminuting wooden material into smaller sized pieces. Typically the raw feed material is waste pieces of logs, timber, or other wood based material which can then be converted into a combustible fuel source suitable for use in boilers, and the like, and which is commonly known as hog fuel.

'Hog fuel' is a combustible solid fuel often used in boilers and which is primarily made up of wood residue from sawmills, logging operations, and various wood off-cuts. Hog fuel typically varies from chipped wood as it commonly may comprise timber of a variety of sizes rather than substantially uniform chips of wood. Typically hog fuel may comprise pieces of wood typically 50mm x 50mm x 120mm down to sawdust. It is commonly made from product which would otherwise be dumped, and may contain a significant amount of foreign materials such as dirt, and stones, depending on the source of the material and how well the material is screened prior to processing.

The machines used to prepare hog fuel are commonly known as 'hoggers' and may also be called reducers, depending on their construction. Quite a number of different sizes exist, and in most case rely on rotating disks or drums with chipping or cutting teeth or features. In many instances these are used in conjunction with a grate which screens reduced material suitable for hog fuel, from product which has not yet been sufficiently reduced. Most designs have a number of flaws or problems associated with them, which at least partially counts for the presence of a number of substantially different standard designs available on the market.

A common problem however is that a common problem affecting most designs however is energy consumption. The process of reducing timber product into smaller reduced pieces suitable for hog fuel consumes a significant amount of energy, and consideration needs to be given to the economy of the process to ensure that the energy expended does not exceed the

resulting energy which can be obtained from what is essentially a low-grade fuel. In a number of instances the specific design of the hogging apparatus has bearing on energy efficiency. These problems will be detailed more fully below.

In the art a variety of different types of hogging apparatus are known, each of which have a number of disadvantages associated with them which affect their efficiency, safety, or ability to process a wide range of material. The common types of hogging apparatus known to the inventor will now be described.

Traditionally devices known in the United States called reducers were used. One design is illustrated in figures 1a and 1b. This basically comprises a horizontally rotating drum (1) with a plurality of teeth (2) distributed thereabout. Shielding the majority of the outer face of the drum is a screen grate (3) which allows processed material of suitably small size to pass therethrough, as well as acting as a safety shield. Positioned in proximity to the teeth of the rotating drum are one or more anvils (4) whose distance of separation from the teeth (2) largely determines the size of the resulting material. As raw material is fed into the apparatus (generally indicated in direction by arrow (5)), the teeth basically mash wood against the anvil and break it down into a reduced size reflecting a distance of the anvil from the teeth. This material is largely carried through an exit via the grate (3).

However, this design suffers from high energy usage and substantial wear on the teeth and anvil. More significantly however, materials such as steel, metal, and very hard rocks can basically jam the system. A typical result is either shearing of the teeth from the drum, or damage to other components. This catastrophic destruction of components can be expensive and time consuming to fix. Given that a lot of forestry material may contain steel pins from logging trucks, or other hard foreign material, this type of apparatus either needs to be precluded from processing such materials, or the raw material subjected to additional time consuming, and potentially expensive, cleaning steps. Given that the hog fuel is a low grade and inexpensive fuel, expensive cleaning steps cannot normally be justified. The high energy usage of this type of apparatus also reduces any profit margin which may be gained from the production of hog fuel.

Additionally, as timber may come from a variety of sources including demolition materials, this type of apparatus also suffers another type of problem related to stringy material. When material such as flax, long fibrous leaves, or carpet are fed into the system, the grate

becomes quickly clogged and the machine stalls as material then becomes wound around the drum. Such material can stall this type of apparatus in as little as three seconds, and may require several hours for it to be pulled apart and fixed.

In another type of apparatus a horizontally rotating drum is placed at the bottom of the shallow pan. The drum occupies an aperture in the base of the pan, and the material is substantially gravity fed towards the rotating drum. Additionally the pan itself may also rotate. This arrangement is shown generally in figures 2a-c.

Processed material exits through a grate (20) covering the portion of the drum (21) positioned below the shallow pan (22). Material too large to pass through the grate (20) is generally returned to the pan and eventually comes once again into contact with the rotating drum. In this type of apparatus there is no anvil, with the drum essentially nibbling at the material within the pan from the bottom. However this type of apparatus has a tendency to fire projectiles upwards thus introducing safety issues. It will effectively eat and nibble away at just about anything though is even more susceptible to steel, and also suffers problems with stringy materials. There is also a very high energy usage for this type of apparatus.

Another variation is a tub-type hogger where a horizontal disk is positioned near the bottom. This disk has teeth about its outer peripheral and also on its top, and sometimes bottom, surfaces. This is generally shown in figure 3a-b. In this type of hogger either the disk (30) can rotate, and/or the tub (3) may rotate around the disk, ensuring relative motion of the raw material which is held within the tub with respect to the disk. The bottom of the tub is essentially a grate (32) which allows processed material of sufficiently reduced size to fall free from the bottom. While this design is less likely to fire high speed projectiles, and is also more tolerant of hard materials such as metal and steel etc, it does suffer from high wear as the raw material is in contact with the rotor all of the time. This continuous contact also reduces energy efficiency and the apparatus requires significant amount of power in order to operate. Further, it has been found that the screening in this type of apparatus can be inconsistent and it depends largely on the amount of material which is in the tub at any one time – for instance, a low load can allow big pieces to pass through while a high load (i.e. lots of material in the tub) may only let much smaller material out.

The fourth type of hogger in usage, though which is relatively uncommon, is like a chipper. It has a rotating disk in which bulk unprocessed material is fed to interact with the top rotating surface. This type of apparatus is very efficient, though is restricted to only processing full stems of material. There is also very high blade wear and it is also very susceptible to steel metal. This type of hogger is typically restricted only for uses where trees are specially grown for fuel, and introduces the added requirement that felled logs must be handled very carefully to avoid picking up rocks or other foreign material which could damage the apparatus.

As can be seen from the above description, quite a range of approaches have been proposed for producing hog fuel. However each one of these designs suffers from one or more disadvantages which are commonly related to safety issues, durability and maintenance of the apparatus, and efficiency of production. From an economical perspective, given the low value of hog fuel, there is a requirement that hog fuel must be produced efficiently and at low cost, and that maintenance and repair costs cannot be to the extent they substantially impact on the profitability of the process.

Therefore there is a need for an alternative process which can provide an efficient means for producing hog fuel, and which ideally is able to process a wide range of materials.

It is therefore an object of the present invention to propose apparatus which represents an alternative and efficient means of producing hog fuel from a range of wood based materials.

It is an alternative object of the present invention to provide apparatus which addresses one or more of the problems affecting the prior art.

At the very least it is an object of the present invention to provide the public with a useful choice.

Aspects of the present invention will be described by way of example only and with reference to the ensuing description.

GENERAL DESCRIPTION OF THE INVENTION

According to one aspect of the present invention there is provided hogger apparatus comprising:

- a rotatable drum inclined to the horizontal, being substantially open at the upper end to allow the feed of raw material therein, and
- including a rotating reducing means within and proximate the lower end of the drum, said reducing means bearing a plurality of features which interact and reduce the size of raw material with which it comes into contact;

the arrangement being further characterised in that at least a portion of the drum has a plurality of apertures acting as screening apertures to allow processed material of sufficiently reduced size to pass therethrough.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the raw material is wood based.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the reducing means is substantially a disc in shape.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the rotational axis of the disc is angled, when the apparatus is viewed in plan, at an angle to the longitudinal axis of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the angle of the disc's rotational axis relative to the drum's longitudinal axis, when viewed in plan, is within the inclusive range of 5°-75°.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the angle of the disc's rotational axis relative to the drum's longitudinal axis, when viewed in plan, is within the inclusive range of 25°-45°.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the rotational axis of the disc is angled, when the apparatus is viewed from the front, at an angle to the longitudinal axis of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the angle of the disc's rotational axis relative to the drum's longitudinal axis, when viewed from the front, is within the inclusive range of 5°-75°.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the angle of the disc's rotational axis relative to the drum's longitudinal axis, when viewed from the front, is within the inclusive range of 25°-45°.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the angle of the disc's rotational axis relative to the drum's longitudinal axis, when viewed from the front, is downward from the longitudinal axis when travelling from the end of the drum where the disc is located and towards the alternate feed end.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the disc rotates in a direction opposite the direction of rotation of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which, when viewed from the end of the drum, the disc is offset to the side with respect to the longitudinal axis of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the features on the reducing assembly for reducing the raw material are teeth.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the drum is substantially barrel-like in appearance.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which there is an associated feed mechanism for delivering raw material into the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the feed mechanism is a conveyer arrangement.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which there is provided, adjacent the internal face of the

drum, at least one rotating agitator to increase turbulence of the bulk raw and processed material in its vicinity.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the rotating agitator is configured and operated to enhance screening efficiency by varying the position and/or orientation of bulk material with which it interacts.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the rotating agitator is basically a rotating shaft with a screw blade thereabout.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the shaft with screw blade is rotated such that the screw blade will attempt to push bulk material towards the feed end of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the rotating agitator comprises a shaft with paddles or blades mounted or formed thereon.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the screening apertures are present over substantially the majority of the outer surface of the drum, at least between the reducing means and the feed end of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the drum is divided into at least two sections, with an inwardly directed flange extending from the inner wall of the drum defining the boundary between different adjacent sections.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which there are two sections, defined as a cleaning section adjacent the feed end of the drum, and a processing section in which the reducing means is present; the inward flange acting as a barrier to the passage of small material to the second processing section.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which said small material is typically stones, dirt, and foreign material.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the size of screening apertures on the cleaning section are smaller than those on the processing section.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the cleaning section includes one or more agitating means.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the configuration and operation of the agitating means is such to knock or wipe small foreign material from bulk unprocessed raw material in the cleaning section, and assist its passage through the screening apertures.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which there is external wiping or brushing means for assisting the clearing and unblocking of foreign material from the screening apertures.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which agitating means in the cleaning section is more vigorous in action than agitating means which may be present in the processing section.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which there is also provided at least one motive means for rotating the drum and reducing means.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the motive means is a combustion engine.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the exhaust from the combustion engine is vented into the interior of the drum to heat, and partially dry, the bulk raw material.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the exhaust is introduced by a pipe with venting apertures therein, which extends along at least part of the length of the drum.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which a significant proportion of exhaust is vented into the drum near the feed end thereof.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, which includes conveying feed means for delivering bulk material into the apparatus.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, which includes clearing means for transporting screened material away from the apparatus.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, in which the clear means comprises conveying means able to deliver transported material into a hopper, trailer, or storage area.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, which includes both conveying feed means and clearing means, the conveying feed means positioned to be substantially over lower clearing means.

According to another aspect of the present invention there is provided hogger apparatus, substantially as described above, which is mounted on to a trailer or vehicle.

Hogger apparatus according to the present invention typically comprises a drum. This drum is substantially cylindrical or barrel-like in appearance and allows a quantity of raw unprocessed material to be held at any given time. Further, it also allows this material to be fed towards reducing means which is responsible for breaking down the raw material into smaller sized pieces.

To achieve this the drum is generally inclined with respect to the horizontal such that the longitudinal axis of the drum is typically inclined at an angle within the inclusive range 5°–45°, and more preferably within the inclusive range of 15°-30°. The direction of inclination

is such that a first end of the drum, which is typically open and represents a means for raw material to be fed into the drum, is at the upper end, while the reducing means which is positioned at or near the other end of the drum, is at the lower end. As the drum rotates about its longitudinal axis, this inclination is affective for gradually progressing raw material from the feed end towards the reducing means.

It will also be seen later that not all material will be sufficiently reduced in size when it first makes contact with reducing means. Accordingly some of this material will be thrown at least partially back up the drum, where the drum's inclination will gradually re-feed it to the reducing means.

The drum typically also has a plurality of apertures about its body which act as a screening apertures to allow sufficiently small materials to pass therethrough. The size of these apertures may be substantially constant, though they may also very in size according to various distribution patterns about the apparatus. For instance, the size of the apertures may reduce as one progresses towards the feed end, allowing for smaller reduced material which may be thrown further up the apparatus to be removed from within the drum as soon as possible. The size, variations, and distribution patterns of the screening apertures will to a large effect be dependent on user choice, and influence the average sized material which will be removed from the system.

While the reducing means may take a number of different forms (including rotating drums), the preferred arrangement is a rotating disk. Ideally this has a majority of teeth or projections on its exposed front face though will typically also comprise teeth or other projections about its circumferential edge, and possibly also behind. Accordingly, a majority of the processing of raw material will be performed preferentially by the front face, though the circumferential edge will also perform significant processing on some of the raw material.

The rotation of reducing means taking the form of a disk may vary according to user choice. There may be some advantage in directing the rotational direction opposite to that of the drum so as more forcefully interact with raw material being rotated and driven towards it. Additionally it can be more likely to throw material back up the drum where it may be more effectively screened by apertures not obscured by a build up of raw unprocessed material.

Larger material will also be re-presented to the rotating disk in a different orientation, which may improve processing efficiency.

In preferred embodiments of the present invention the disk is also angled in a number of ways. When the apparatus is viewed from above, the disk may be angled with respect to the longitudinal axis of the drum. In a preferred embodiment the difference in the rotational axis of the disk to the longitudinal axis of the drum is within the inclusive range of 5° through 75°. More preferably, in preferred embodiments, this difference is within the inclusive range of 25° through 45°.

The disk may also be inclined in other directions as well. For instance if we viewed the hogger apparatus from the front, such that we are viewing the side of the drum rather than an end thereof, the disk may also be inclined relative to the longitudinal axis of the drum. The difference between the rotational axis and longitudinal axis may again be within the inclusive range of 5° through 75° inclusive, though more preferably within the smaller inclusive range of 25° through 45°. Ideally, when viewed from the front, an inclined disk will be such that its lower most edge is closer to the open feed end of the drum than will be its topmost edge.

These modifications are considered to improve the efficiency of the apparatus, though need not be employed in every embodiment. It was considered that a major problem relating to the wear and efficiency in some of the prior art designed resulted from the rotating disk or reducing means being totally and continually covered with bulk material to be processed. This constant contact, which included contact with both unprocessed material, and material yet waiting to be screened, substantially reduced efficiency and imposed quite high requirements on the amount of power required to drive the disk or drum. By appropriately angling and positioning the disk it is envisaged that only a portion of the disk will be presented in any one time (unless drum is overloaded) with raw material waiting to be processed, and that at least a portion of partially processed material will be flung further back up the drum where it has the opportunity to be screened before being reintroduced to the rotating disk.

Other improvements have been proposed to hogger apparatus according to the present invention. For instance, it has been considered to include agitating means which increases the agitation of bulk material in the vicinity of the screen. Typically this may be achieved by

including a rotating element which basically creates turbulence so that material in the vicinity of the screen may be tumbled, re-orientated, and presented to the screening apertures in different orientations. This agitation may also allow sufficiently reduced material, able to pass through the screening apertures, to be presented to the screening apertures in the instance they might otherwise have been blocked from contact with same by material that was too large in size. Accordingly, it is considered that introducing agitating means can improve the efficiency of the screening process, which in turn affects the efficiency of the overall process.

Agitating means may be introduced in a number of ways. A simple method is to provide a shaft with a helical screw or blade passing about its outer face. Rotating this screwed shaft can effectively introduce some turbulence. Ideally the direction of rotation is such that the screw will be attempting to drive material back up the drum and away from the reducing means. This further prolongs the period during which the material is able to be exposed to a screening process before being reintroduced to the reducing means.

Other designs may also be adopted for agitating means. Different shaft designs bearing blades, paddles and other mechanical equipment may also be considered. However the main object of the agitation means remains the same, to improve the efficiency of the screening process ideally by introducing turbulence and agitation in the vicinity of the screening apertures.

More than one agitation means may be provided in the apparatus though it is considered that economy and efficiency favours the use of one suitably positioned agitation means, ideally positioned so as to interact with a significant proportion of the material which is settling within the drum.

A further problem affecting hogging apparatus is the presence of foreign material. Not only does steel in rocks pose a problem, but also non combustible material such as dirt, clay, small stones etc. A simple modification has been proposed for some embodiments which will improve the separation and removal of such material from the bulk raw material.

It is proposed that the drum is divided into sections. The manner of forming a boundary between the sections can be the presence of an inwardly directed flange extending from the

inner face of the drum. The height of this flange may be relatively shallow as we do not wish to form a total dam to the progress of material.

Accordingly it may only comprise 5-10% of the diameter of the drum though this may very according to the type of material typically being processed. It is envisaged in preferred embodiments that this barrier will typically be of 25-250 mm in height, and typically in the range 40-100 mm.

This sectioning into what will be conveniently described as an initial cleaning section, and subsequent processing section, can be further improved if agitation apparatus is also introduced into the cleaning section. The agitation apparatus in the cleaning section may be more vigorous in nature and serve to knock and wipe foreign material such as dirt, small stones, and clay etc which may be attached to bulk material being fed into the apparatus. It is also envisaged that the inward flange will act as a barrier to prevent this removed small material from travelling into the second section while the larger bulk material will have no real difficulty in progressing through the apparatus. The majority of foreign material will then be able to exit via apertures provided in the cleaning section. These apertures may be of a smaller size than in the subsequent processing section, so as to only allow this typically smaller foreign material to pass through and to be suitably removed after exit from the apparatus.

As some of this material may be wet and sticky, and may clog screening apertures associated with the cleaning section, wiping or brush like means may be provided to help clear these apertures. Typically this may be provided on the outside of the apparatus for convenience, and to avoid damage thereto by the bulk material.

Typically the apparatus will require motive means to drive rotation of the reducing means and the drum. Various types of motive means, and more than one motive means, may be employed. However it is envisaged that in most cases a combustion engine, typically a diesel engine, will be relied upon to drive the apparatus. When such motive means are used, an additional advantage may be realised. Such combustion engines have an exhaust which comprises a significant amount of heat. By suitable venting of these exhaust gases to within the interior of the drum, the bulk material can be heated. In the situation where the raw material is damp or wet, this can provide a useful drying effect which in turn increases the true calorific output of the resulting fuel, and hence its value to the operator.

Exhaust gases may be introduced in a number of ways. Perhaps the simplest way which is proposed by the inventor is to introduce a shaft from along at least part of the length of the drum and which has a number of apertures therein which allow the venting of exhaust gases inside the drum. The size and position of the exhaust gases may be varied to either give a substantially even output of exhaust gases along its route, or to concentrate the release of exhaust gases where they are able to do the most good. This may be where the greatest concentration or bulk of processed materials lies (i.e. in the vicinity of reducing means). However, in embodiments where there is a cleaning section, enhanced drying in this section may improve subsequent processing as well as improving the removal of wet dirt, clay, and similar types of foreign material.

The apparatus may also include feed means to feed raw material within the drum. In a preferred embodiment a dual conveyor system is incorporate which allows delivery of bulk material into the apparatus, as well as removal of comminuted material. Various arrangements may be considered, and may also be catered for by an independent existing conveying system.

The apparatus may be constructed to sit on the ground or, as in one embodiment to be described later, mounted on a trailer so that a mobile unit is obtained.

DESCRIPTION OF DRAWINGS

Different aspects of the invention will be described with reference to the accompanying drawings in which:

Figures 1a, b are perspective diagrammatic views of a typical horizontal drum hogger of the prior art;

Figure 2a-c are perspective diagrammatic views of a typical tub grinder of the prior art;

Figure 3a, b are perspective diagrammatic views of a typical tub-type hogger of the prior art;

Figure 4 is a front cut-away perspective view of the drum portion of a preferred embodiment of hogger apparatus according to the present invention;

Figure 5 is a front full view of a variation of the embodiment of figure 4 when mounted on a trailer, with some portions cut-away for clarity;

Figure 6 is a top plan cut-away view of the drum portion of the embodiment of figure 4;

Figure 7 is a perspective cut-away view showing detail near the lower end of the drum portion of the embodiment of figure 4;

Figure 8 is an alternate perspective of the region of figure 7;

Figure 9 is a front view of the full embodiment of figure 5 in an unfolded orientation, and

Figure 10 is a perspective view showing the conveying portions of the embodiment of figure 5.

DESCRIPTION OF PREFERRED EMBODIMENT

With reference to the drawings and by way of example only there is provided hogger apparatus such is best illustrated in figure 4. The hogger apparatus comprises a drum, (40) which comprises a structural metal frame overlaid with a metal grate panels (41). For simplicity of viewing, the grate (41) is not shown in all of the figures. The grate is typically of a steel though other suitable materials can be substituted. The panels may be removable for repair and access to internal components of the apparatus.

Figure 5 illustrates hogger apparatus (generally indicated by section 42) as part of mobile apparatus including feed and removal means (to be discussed more fully later). In figure 5 the inclination of the drum (40), from the horizontal, is shown. In this figure bulk material is fed from the right hand side into the apparatus.

Positioned at the lower end of the drum, and on the inside, is a rotating disk assembly (45) with a plurality of teeth (46) about its periphery. These may be fixed and/or swinging teeth (as known in the industry) The disk (45) is inclined in a number of manners. Referring to figure 6, which is a top plan view of the apparatus, the angling (nominally around 30°) of the disk with respect to the horizontal axis of the drum (40) is clearly visible. Mounting means (48) for holding the disk (45), and also transmitting drive from pulley (49) is also visible in

figure 6. In figure 5 it can also be seen that the disk (45) is also angled downwardly with respect to the longitudinal axis of the drum (40). This angling corresponds to the deviation of the longitudinal axis of the drum (40) from the nominal horizontal (i.e. the ground), i.e. an angle of around 10°.

The interior of the drum (40) is divided into two sections by the inwardly directed flange (50). This extends by a height of approximately 50 mm inwardly of the inner surface of the drum. This section divides the drum into an initial cleaning section (55) and main processing section (56).

In practice, new unprocessed material as it enters the drum (40), will have a significant amount of dirt and foreign material shaken from it as it falls into the drum. The inwardly directed flange (50) acts as a barrier to prevent the majority of this material from entering into the subsequent processing section (56). The majority of this material will fall through the screen (57) associated with the cleaning section (55).

To further improve the efficiency of foreign material removal, agitating means in the form of shaft (60b) is provided in the cleaning section (55) to further agitate material.

Positioned about the periphery of the drum are a plurality of wiping blocks (62) with flexible blades and/or brushes which wipe clean the apertures of screening grates (57).

The agitating means (60b) is also part of an agitating means (60a) which extends through the processing section (56). While separate agitating means could be used, it has been found that it is simpler in design and efficiency to use a common shaft with helical screw blades thereabout. It can be clearly seen in figure 4 that the rotation orientation of the helical blades differs for the two sections.

In practice bulk material which finds its way into the processing section (56) will ultimately come into contact with the rotating disk (45). At this time reduction or comminution of at least part of the bulk material will occur. Typically also, the rotation of the disk will attempt to fling the processed material upwards and further up the drum towards the opening. This has a tendency to present the flung material against relatively clear sections of grate before it tumbles towards the bottom of the drum. This material, as it finds its way back down to the bottom end of the drum will, due to the rotational axis of the drum, typically follow a shark

toothed or saw-tooth type pattern of movement if its path is traced from a view point at the front of the apparatus (e.g. figure 5). This motion tends to continually represent reduced material to fresh screening apertures to ensure that it has every possibility of escaping through the screen/grate if it is of sufficiently reduced size. This also reduces the possibility of large oversized material from continuously blocking the screen and thus preventing removal of the reduced size pieces. Additionally also, this tumbling motion within the apparatus continually re-orientates the various pieces of material. This can improve the screening process, as well as continually re-presenting the material to the rotating disk (45) at different orientations, which may improve overall efficiency.

Further enhancing this tumbling process, and the screening process, is the presence of the agitating means (60a). The agitation thereby induced at the bottom portion of the rotating drum (40) can further increase the efficiency of screening. Accordingly, a number of different motions are being performed on the various material within the drum, and which are largely absent in the prior art which typically suffers from screening problems. It should also be associated that the degree of agitation and tumbling provided can be performed at a relatively slow speed, thereby minimising screen and component wear, but with good screening efficiency.

It has previously been mentioned in general section that a further advantage may be provided by also providing heating means. Here a manifold (70) is provided to direct exhaust from the driving motor to a pipe (71) which then distributes exhaust gases along the length of the drum (40). In this example heat is radiated along the length of the pipe. In this example also, the majority of exhaust gases are vented into the cleaning section (55).

To assist loading and unloading of material into the apparatus, a dual conveyor system, generally indicated by arrow (80), has been proposed. This comprises an upper conveyor system (81) which feeds bulk material into the drum (40). Collecting screened material from underneath the apparatus is a secondary conveyor system (82) which feeds a loading conveyor (83) which can deliver screened material into a suitable hopper (85). The secondary conveying system (82) extends under substantially the entire length of the drum (40), as is partially visible in figure 9. It can also be seen that the loading conveyor system (83) pivots into position from its normal folded position (figure 5) to the extended position visible in figure 10.

The entire apparatus may be mounted on suitable trailer (88) which enables it to be moved from site to site. It is also envisaged that fixed, stationary embodiments may also be provided according to the present invention.

In practice raw material is loaded onto other conveyor (81). Typically this may be by excavator bucket, or front end loader bucket, or by grapple. This largely depends on the nature of the material being loaded. It is also possible that a conveyor system which leads onto feed conveyor (81) might be used in some embodiments.

Bulk material is then fed into the clockwise rotating drum (40) (when looking down the drum towards the disk) where it progresses through the cleaning section (55) and to processing section (56). As it encounters the rotating disc – typically from the left when looking down the drum towards the disc which is rotating anti-clockwise – it encounters the teeth and part of the material will be flung to the right and against the screen of the drum. Suitably reduced material may fall free at this stage or during further tumbling action due to the drum and counter-clockwise rotating agitating means, which also acts to force product further up the drum towards the feed end..

As material of suitably reduced size is produced and screened from the drum, it finds its way onto a lower conveyor (82). It is possible that additional screens and guides may be used to guide the material exiting from the screens of at least the processing section to fall onto lower conveyor system (82). Additionally, shielding associated with the cleaning section (55) may be provided to prevent foreign matter and material from falling onto the lower conveyor (82). Such additional external screens and guides may in fact divert removed material in the cleaning section to either side of the conveyor.

As the conveyor (82) removes reduced material from underneath the drum, it feeds it to further optional conveying means (83) which is able to load the material onto the back of a truck or hopper (85).

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the spirit or scope of the present invention as described herein.

It should also be understood that the term "comprise" where used herein is not to be considered to be used in a limiting sense. Accordingly, 'comprise' does not represent nor define an exclusive set of items, but includes the possibility of other components and items being added to the list.

This specification is also based on the understanding of the inventor regarding the prior art. The prior art description should not be regarded as being authoritative disclosure on the true state of the prior art but rather as referencing considerations brought to the mind and attention of the inventor when developing this invention.

RODNEY WARWICK SHARP
By his Attorneys

PIPERS CENTRAL

HORIZONTAL DRUM DEGGER.

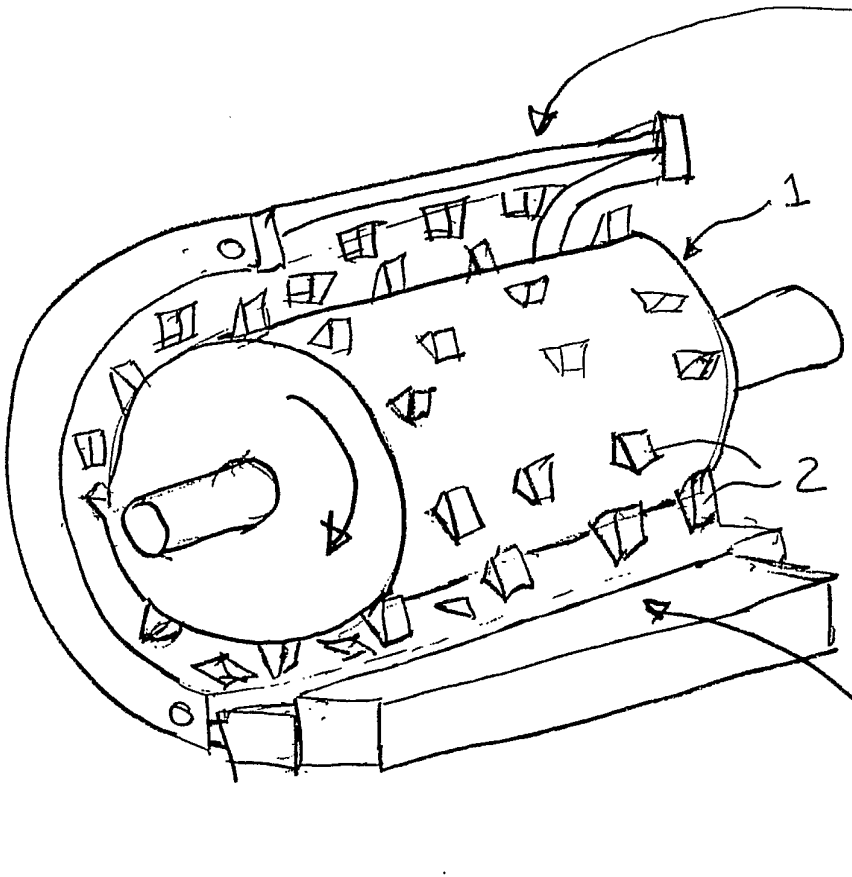


FIG 1a

'U' SHAPED GRATE TO EJECT PROCESSED PRODUCT THROUGH

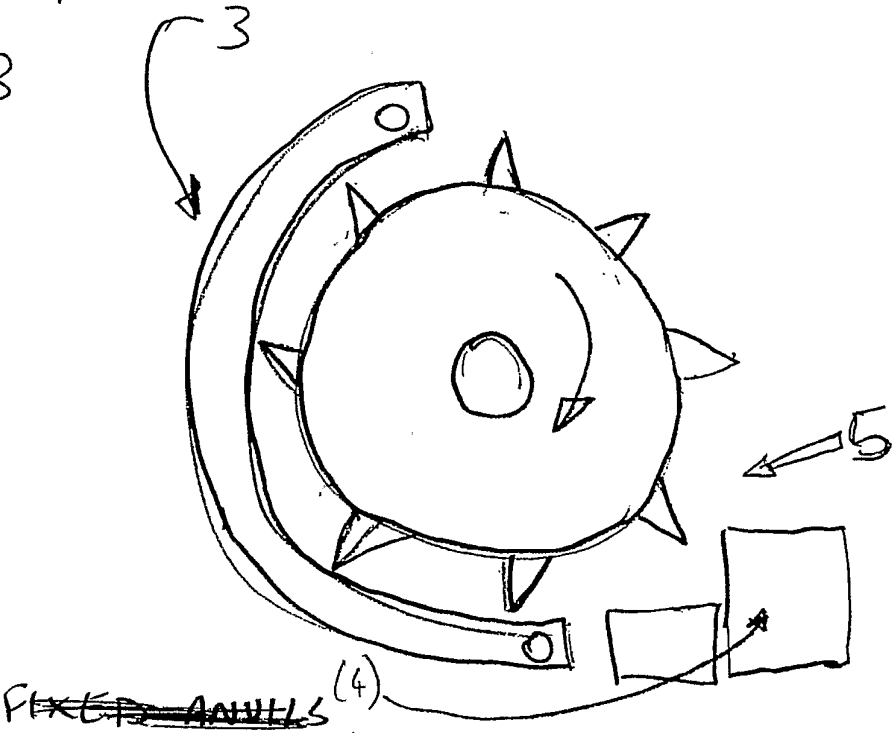


Fig 1b

PRIOR ART

PRIOR ART

TUB GRINDER.

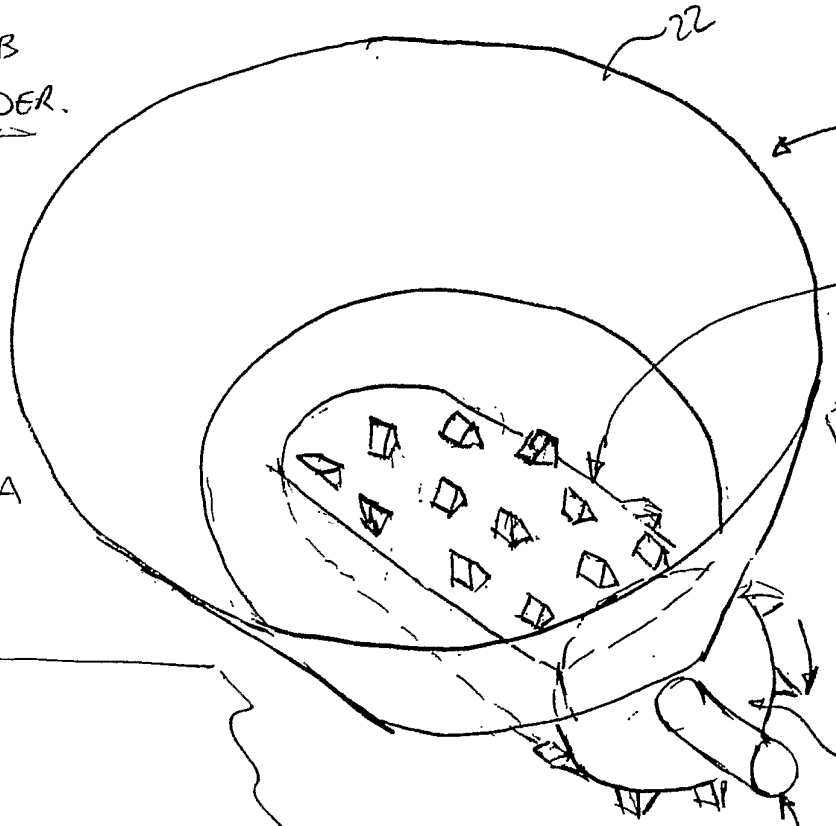


FIG 2A

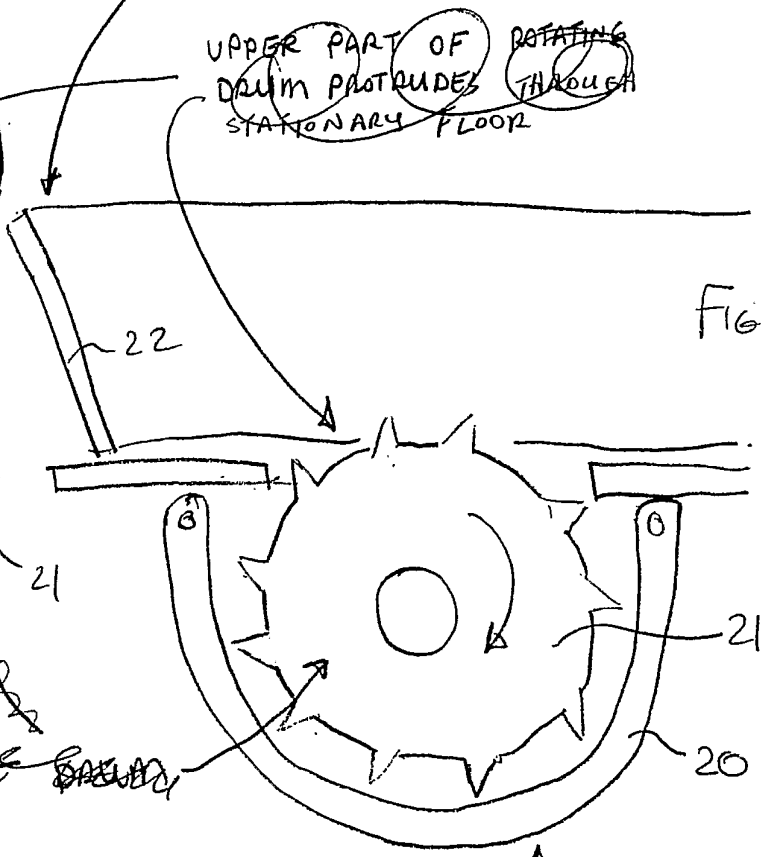


FIG 2B

FIG 2C

VERTICAL SHAFT HOGGER

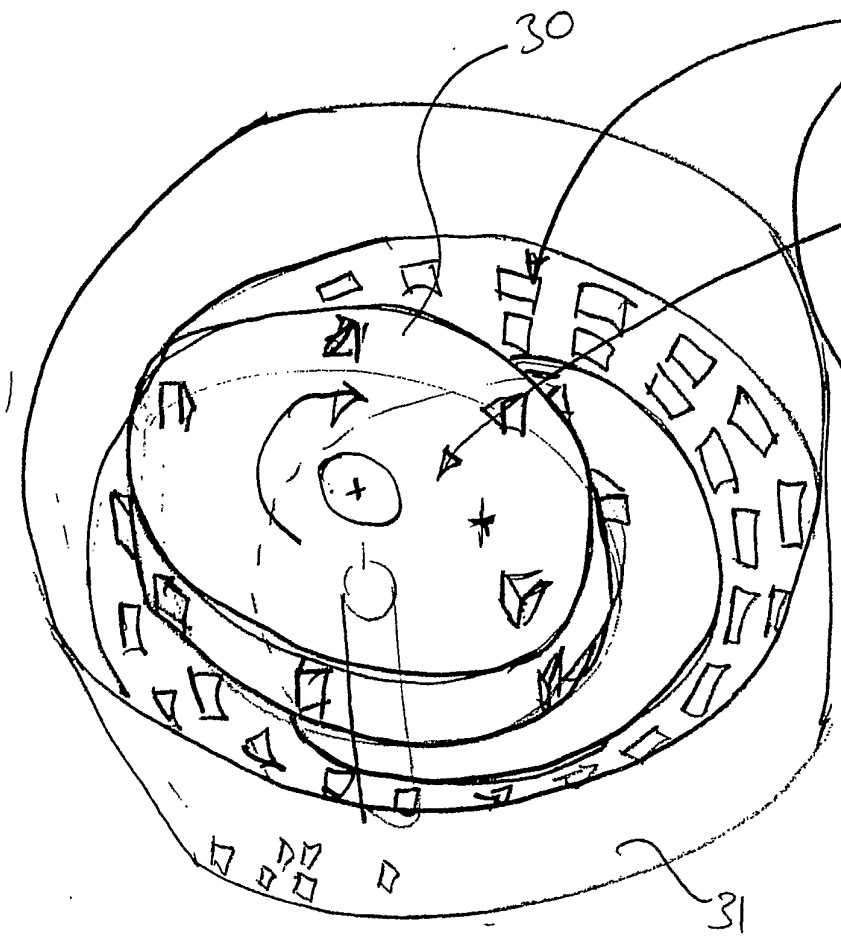


Fig 3A

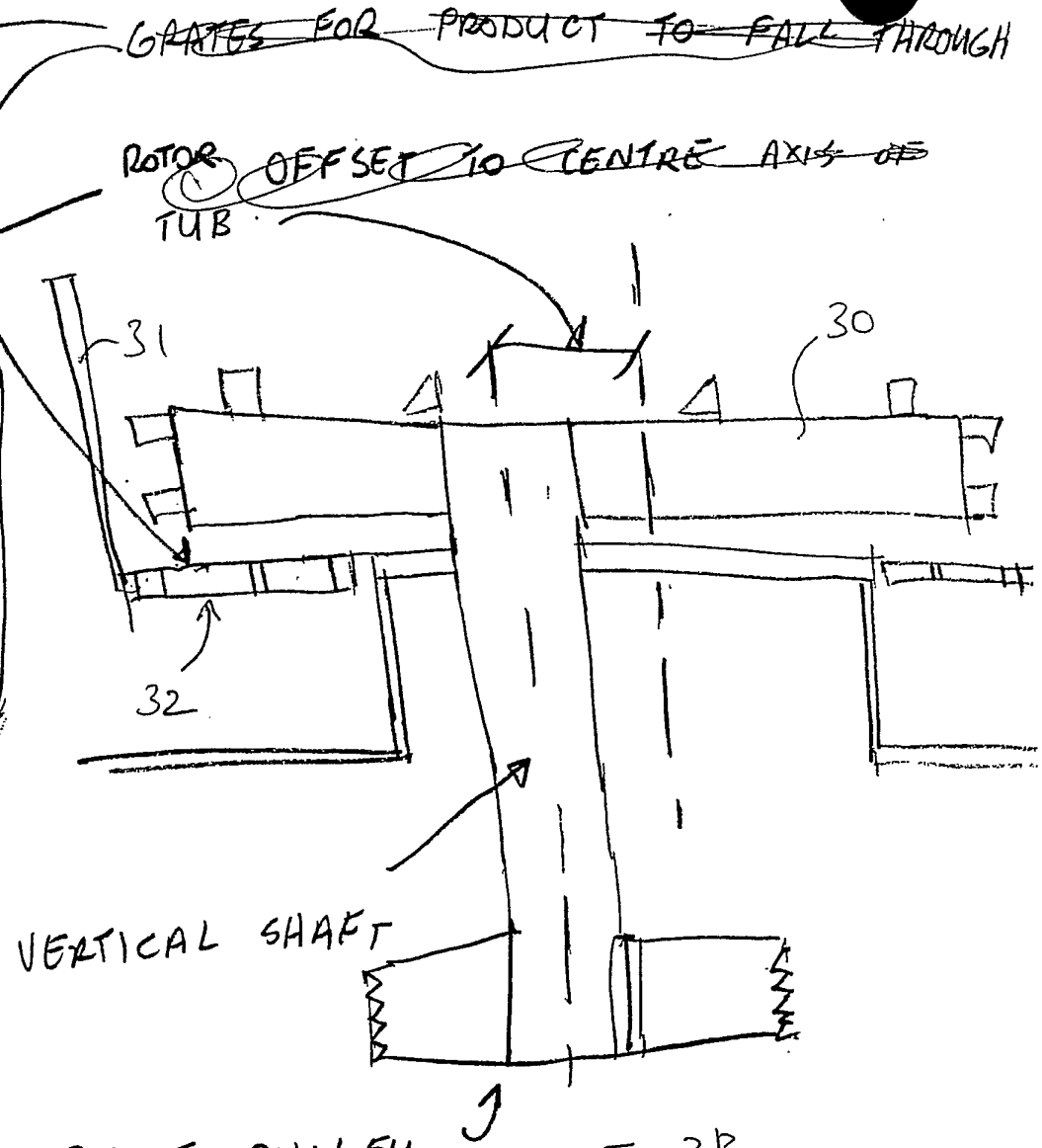
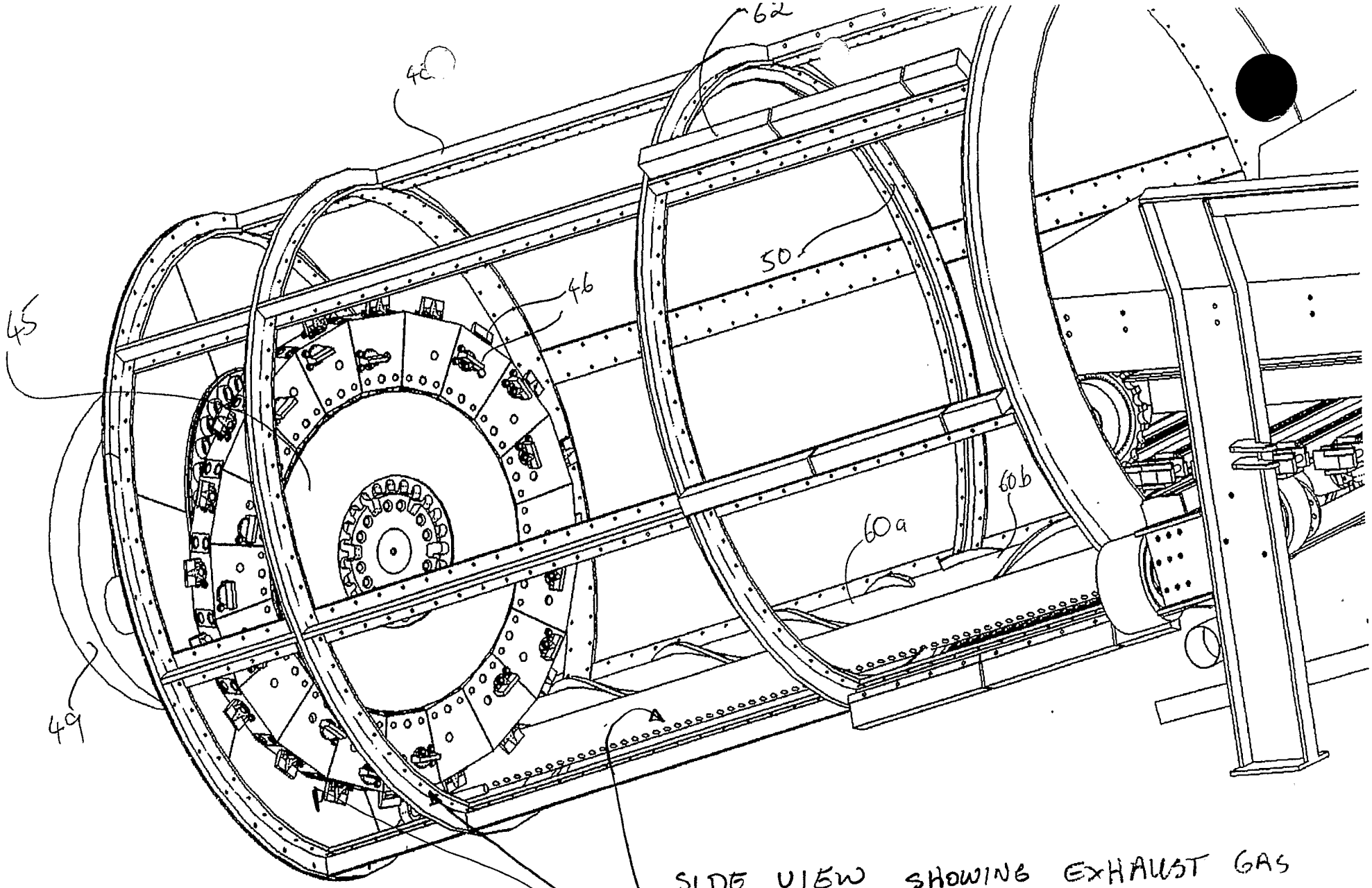


Fig 3B

PRIOR ART



SIDE VIEW SHOWING EXHAUST GAS EXIT HOLES

REMOVABLE SCREENING PANELS FIX IN OUTSIDE CAVITIES OF DRUM

FIG 4

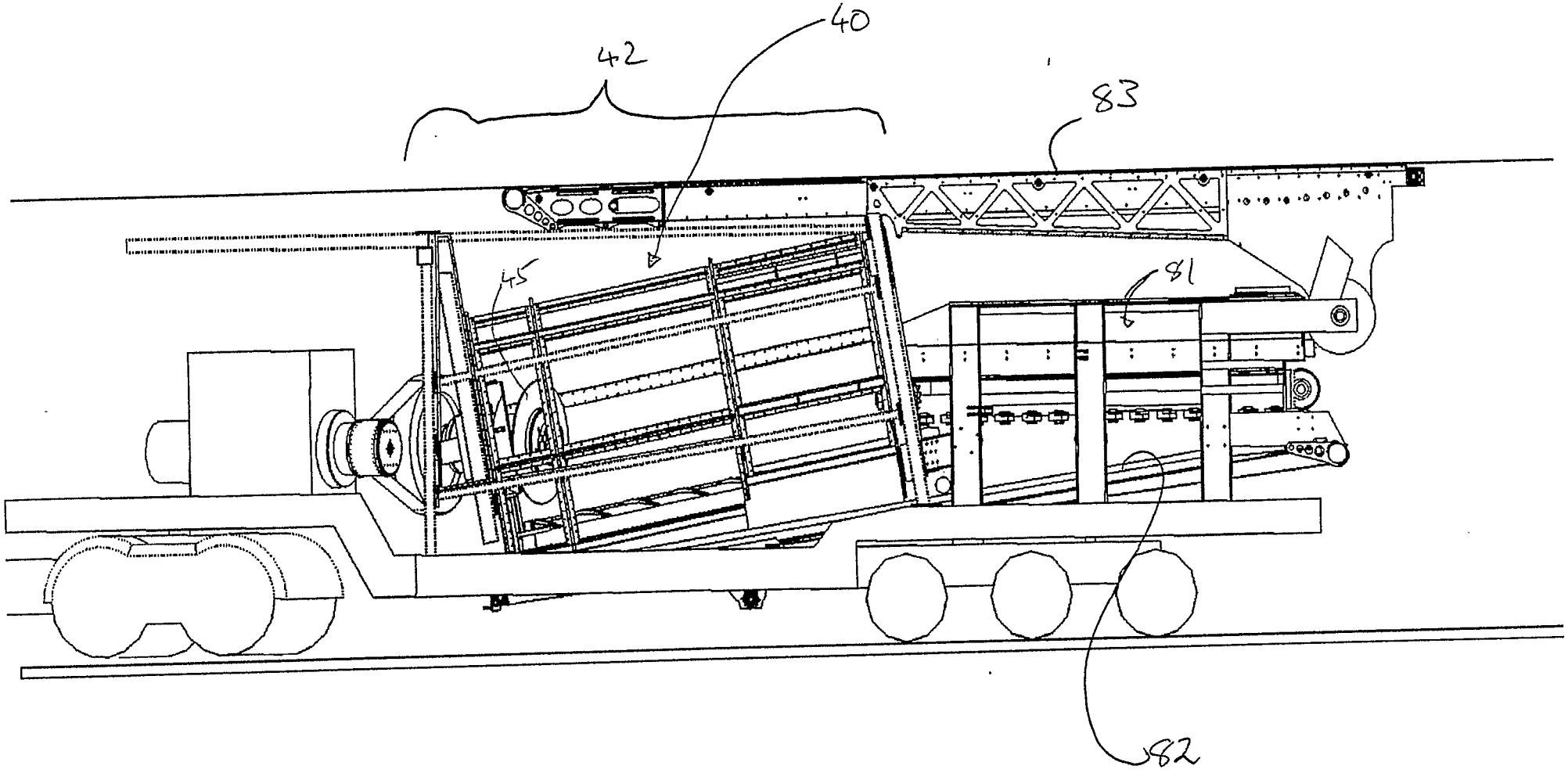
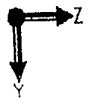
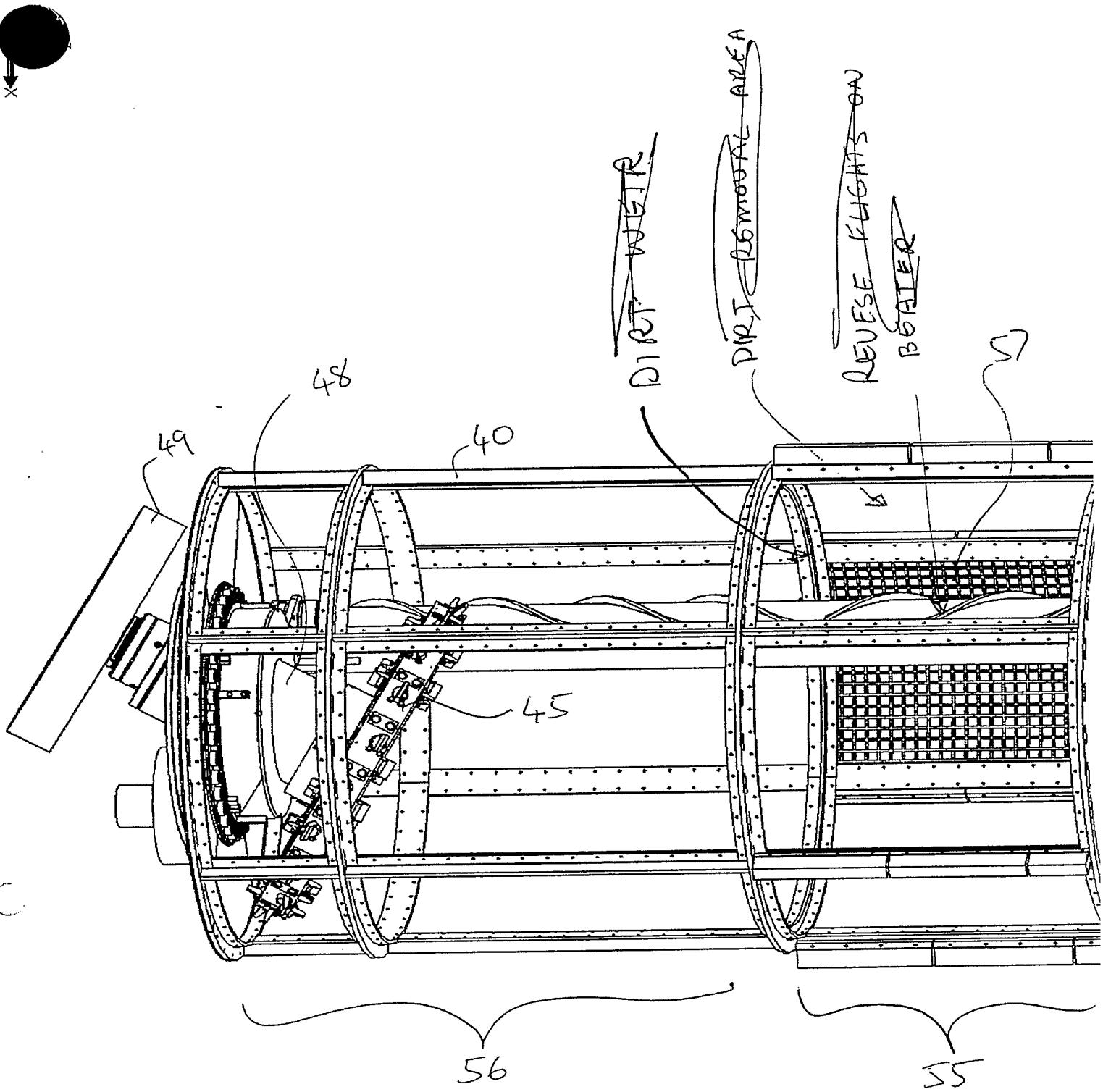


FIG 5





PLAN VIEW

FIG 6

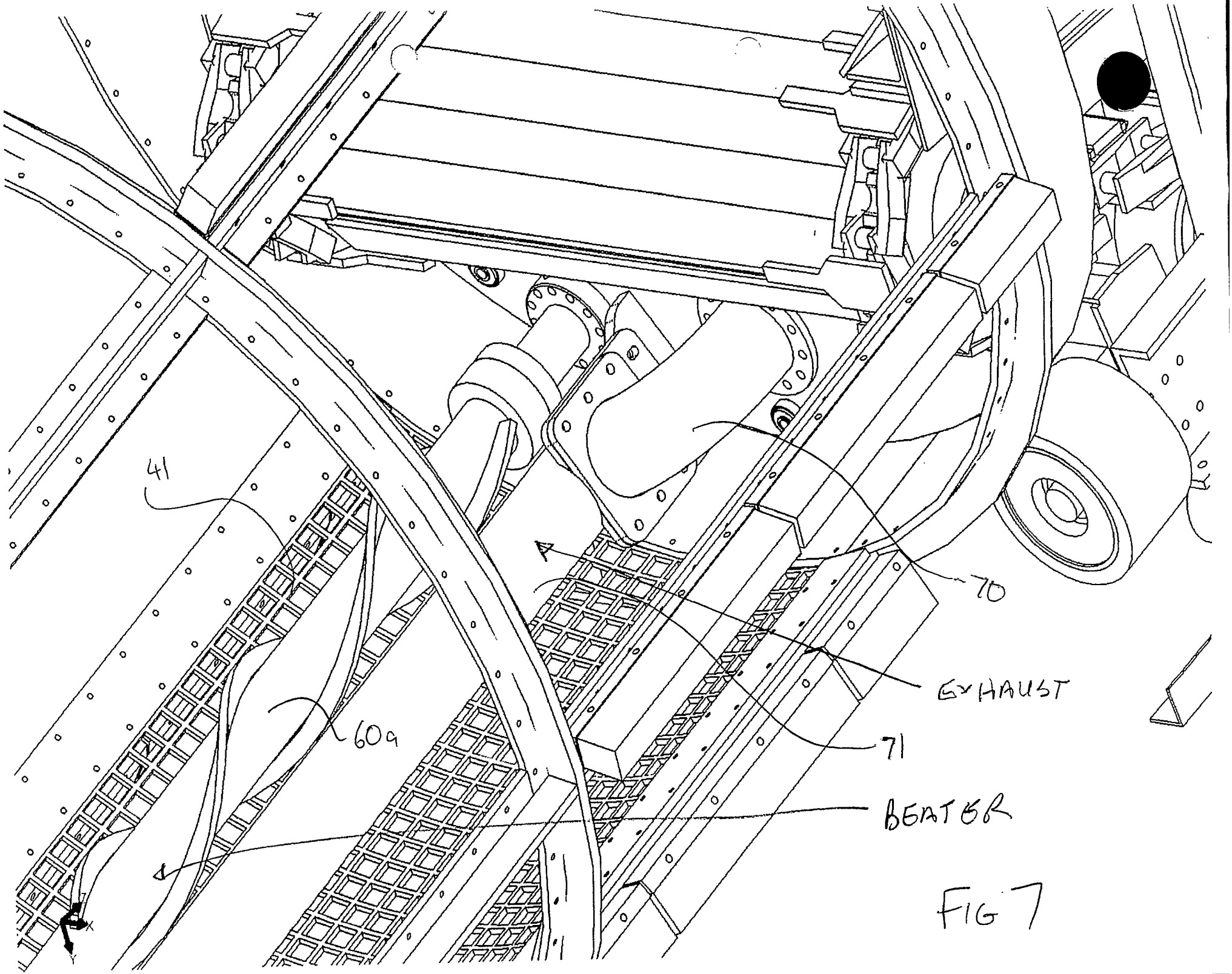


FIG 7

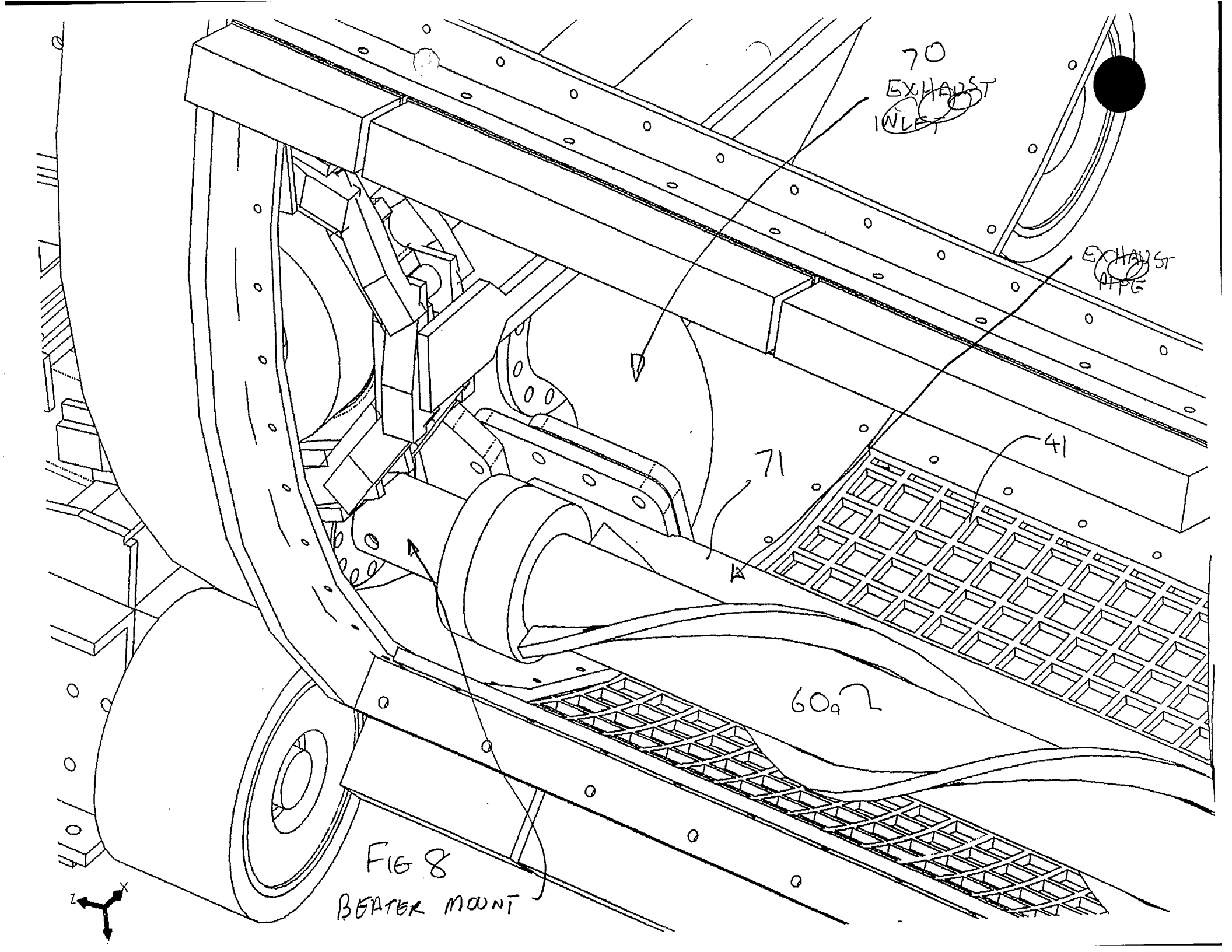


FIG 8
BEATER MOUNT

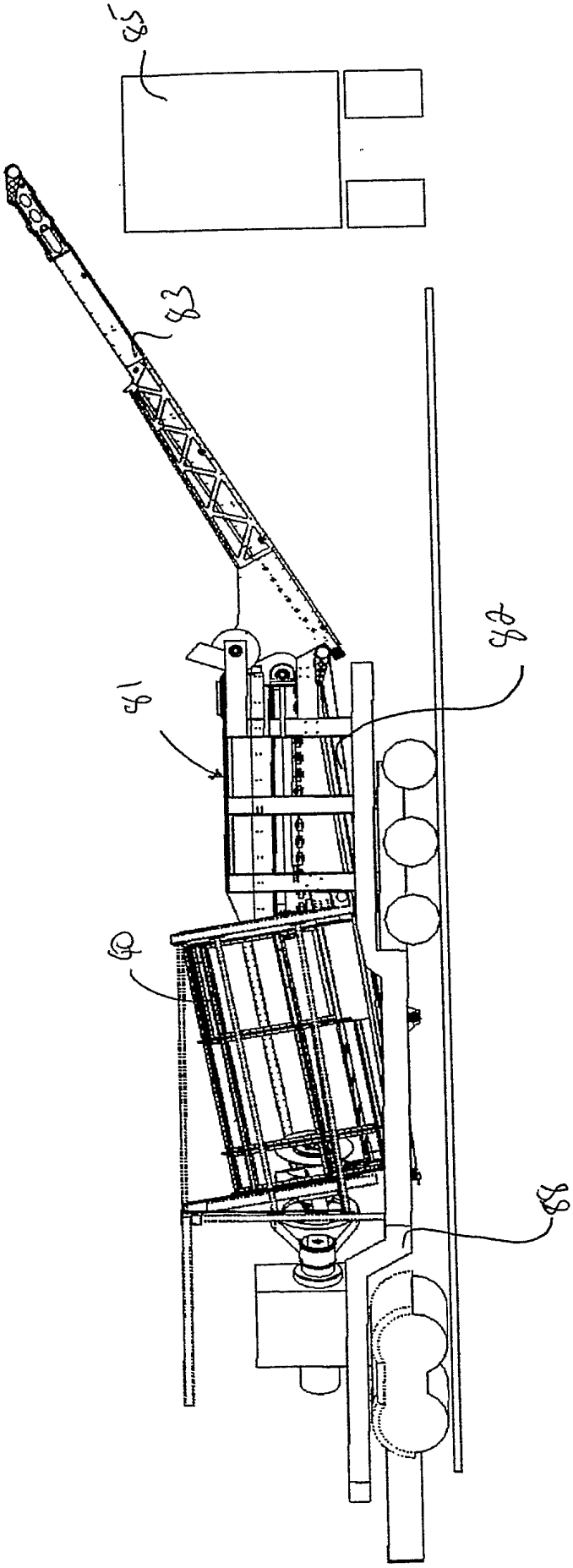


FIG 9

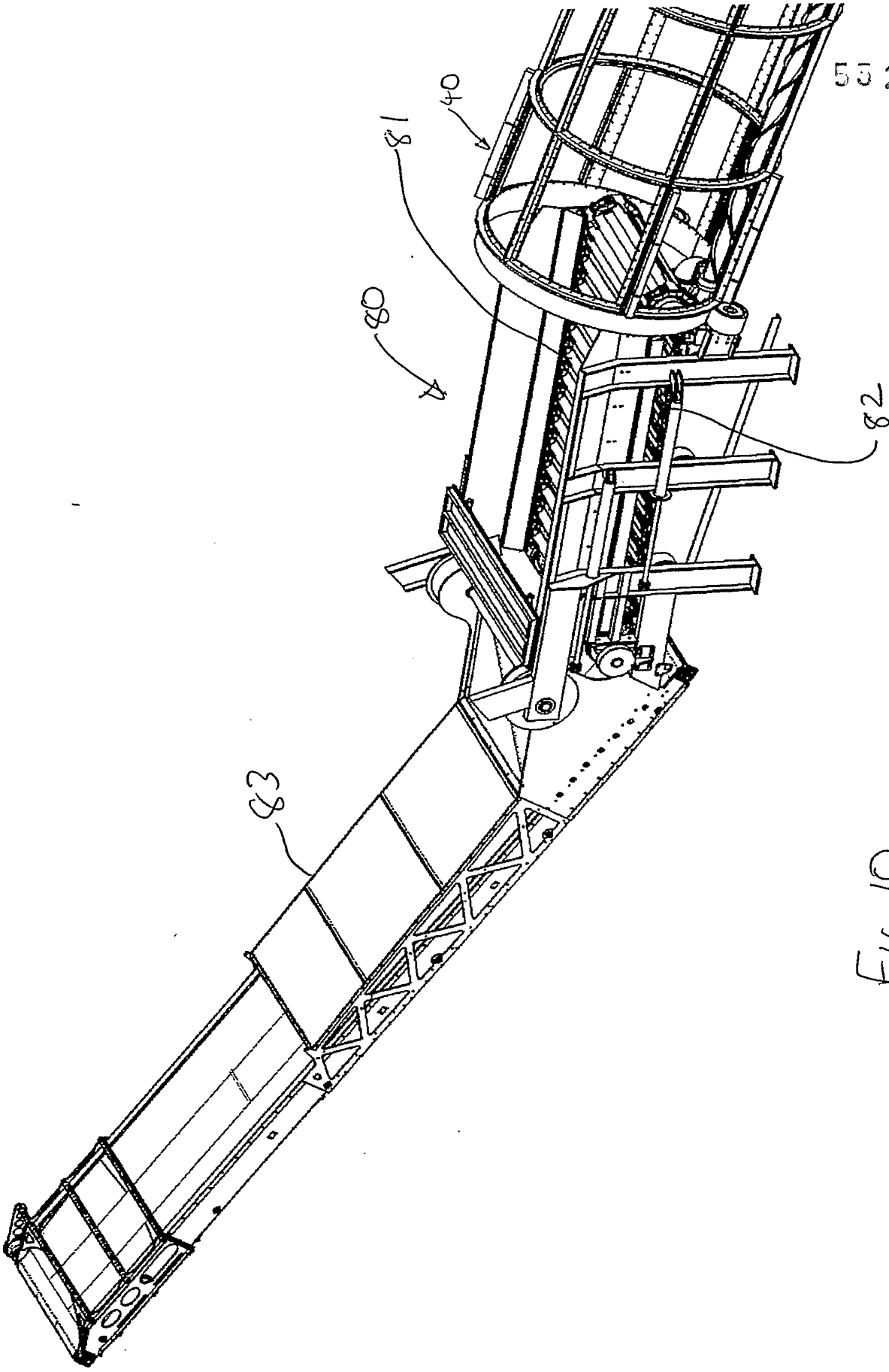


FIG 10